

# THIN FILM CATALYST LAYERS FOR DIRECT METHANOL FUEL CELLS

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One of the primary obstacles to the widespread use of the direct methanol fuel cell (DMFC) is the high cost of the catalyst. Therefore, reducing the catalyst loading well below the current level of 8-12 mg/cm<sup>2</sup> would be important to commercialization.

The current methods for preparation of catalyst layers consisting of catalyst, ionomer and sometimes a hydrophobic additive are applied by either painting, spraying, decal transfer or screen printing processes. Sputter deposition is a coating technique widely used in manufacturing and therefore particularly attractive. In this study we have begun to explore sputtering as a method for catalyst deposition. Present experiments focus on Pt-Ru catalyst layers for the anode.

Pt-Ru films were sputtered at in 20 mtorr Argon, directly onto the Nafion 117 membrane and/or carbon electrode. The loading levels of anode catalyst layers were in the range of 0.05 mg/cm<sup>2</sup> to 1 mg/cm<sup>2</sup>, depending on the duration of the sputter-deposition process. This process has the advantage of providing uniform, thin, porous and adherent catalyst layers. The cathode catalyst layers were applied by a conventional painting process. Single cells were characterized at 60 and 90°C with oxygen and air. Anode polarization measurements were also carried out. Thin films were investigated by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM) and Rutherford Backscattering Spectroscopy (RBS).

XRD of PtRu film sputtered on Nafion show that the peak positions are close to those obtained for chemically prepared Pt-Ru catalyst alloy particles. Film thicknesses were measured by RBS and SEM are in the range of 145- 2000 nm, and these values are consistent with weight changes measured before and after

sputter deposition and corresponds to loading levels of 0.03- 1 mg/cm<sup>2</sup>.

Figure 1 shows V-I characteristics of a 25 cm<sup>2</sup> cell at 90° C with air at 20 psig. At 300 mA/cm<sup>2</sup> the performance is about 0.395 V. The cell performance increases with catalyst loading for the series 0.1, 0.3, 1 mg/cm<sup>2</sup>, but when this number is normalized by the amount of catalyst per cm<sup>2</sup> used at the anode, the catalyst utilization expressed as mW/cm<sup>2</sup>/mg is impressive. Results suggest that high utilization can be achieved by optimization of composition and deposit structure. The results of characterization will be discussed.

## Acknowledgements

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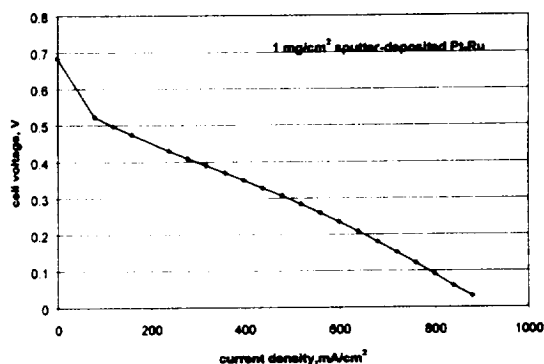


Fig. 1 Electrical Performance of DMFC with sputter-deposited Pt-Ru anode, at 90°C, 1M methanol and 20 psig air; electrode Area: 25 cm<sup>2</sup>